What is claimed is:

1. An apparatus for recognizing a gray scale image, comprising:

    inputting means for inputting a gray scale image; and

    multi-code image binary-coding means for converting the inputted gray scale image to a binary image in which each pixel has a value representing either a background area or a plotting area in the gray scale image.

2. An apparatus for recognizing a color document image, comprising:

    gray scale image extracting means for extracting a gray scale image from an inputted color document image; and

    multi-code image binary-coding means for converting the gray scale image to a binary image in which each pixel has a value representing either a background area or a plotting area in the gray scale image.

3. An apparatus for recognizing a color document image, comprising:

gray scale image extracting means, when an inputted document image is a color document image, for extracting a gray scale image from the color document image; and

5   multi-code image binary-coding means, when an inputted document image is a color document image, for converting a gray scale image extracted by the gray scale image extracting means to a binary image in which each pixel has a value representing either a

10   background area or a plotting area in the gray scale image, or when an inputted document image is a gray scale image, for converting the gray scale image to a binary image in which each pixel has a value representing either a background area or a plotting

15   area in the gray scale image.

4.   The apparatus according to claim 1, further comprising

binary image recognizing means for recognizing

20   a binary image outputted by said multi-code image binary-coding means and electronically coding the binary image.

5.   The apparatus according to claim 1, wherein said

25   multi-code image binary-coding means includes

partial area extracting means for one or more partial areas in the gray scale image,

partial image binary-coding means for executing a binary-coding process for each of the partial areas of the gray scale image and extracting a partial binary image, and

binary image combining means for combining the one or more partial binary images and for constituting the binary image of the entire scale image.

6. The apparatus according to claim 5, wherein said binary image combining means sets a pixel value in the binary image to be outputted, corresponding to a pixel which is not contained in any of the partial areas in the gray scale image to a value of a background color.

7. The apparatus according to claim 5, wherein said binary image combining means calculates a pixel value in the binary image to be outputted, corresponding to a pixel which is contained in one or more of the partial areas in the gray scale image, by a logical operation
in which corresponding pixel values in the partial binary images obtained from each partial area are combined.

8. The apparatus according to claim 5, wherein said binary image combining means assigns a corresponding pixel value in the partial binary image obtained from the partial area with top-priority which is determined

5 based on a quantitative priority according to a predetermined criterion as a pixel value in the binary image to be outputted, corresponding to a pixel which is contained in one or more partial areas of the gray scale image.

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9. The apparatus according to claim 5, wherein said partial area extracting means extracts one or more partial areas where both background color and plotting color of the gray scale image each have a specific

15 gray scale value.

10. The apparatus according to claim 5, wherein said partial area extracting means outputs one or more rectangular areas as the partial areas.

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11. The apparatus according to claim 5, wherein said partial area extracting means extracts one or more partial areas using an edge strength image or edge direction image obtained by executing an edge

25 extracting process for the gray scale image.

12. The apparatus according to claim 11, wherein the edge extracting process is executed using either a Zobel filter or a Laplacian filter.

13. The apparatus according to claim 11, wherein said partial area extracting means calculates an edge binary image representing an outline of a plotting stroke by the edge extracting process and extracting the one or more partial areas based on this edge binary image.

14. The apparatus according to claim 13, wherein said partial area extracting means calculates the edge binary image by executing a binary-coding process for the edge strength image corresponding to the gray scale image.

15. The apparatus according to claim 13, wherein said partial area extracting means calculates said edge binary image of which the edge outline is somewhat contracted by executing a binary-coding process for the edge strength image corresponding to a gray scale image to calculate a temporary edge binary image, shifting each edge pixel of the temporary edge binary image in the forward or backward direction of the edge

direction image to contract the outline formed by the edge pixels.

16. The apparatus according to claim 13, wherein said partial area extracting means calculates coupling elements of the edge element of the edge binary image and calculates each of the partial areas based on each of the coupling elements.

17. The apparatus according to claim 16, wherein said partial area extracting means calculates a circumscribed rectangle of each of the coupling elements as each of the partial areas.

18. The apparatus according to claim 16, wherein said partial area extracting means calculates an overlapping rectangle of a circumscribed rectangle of each of the coupling elements as each partial area.

19. The apparatus according to claim 13, wherein said partial area extracting means judges an extremely long outline from outlines composed of edge pixels in the edge binary image to be a ruled line, removes the extremely long outline and extracts the partial area based on an edge binary image which is composed of

only remaining edge pixels.

20. The apparatus according to claim 19, wherein said partial area extracting means stores and outputs an outline portion judged and removed as the ruled line, as a ruled-line binary image.

21. The apparatus according to claim 20, wherein said binary image combining means performs a logical operation between a binary image generated by said binary image combining means and the ruled-line binary image stored and outputted, and outputs an obtained binary image.

22. The apparatus according to claim 13, wherein said partial area extracting means judges outlines of a predetermined length sequentially arranged in a lateral or vertical direction from outlines composed of edge pixels in the edge binary image to be ruled lines, removes the outlines and extracts the partial area based on an edge binary image which is composed of only remaining edge pixels.

23. The apparatus according to claim 22, wherein said partial area extracting means stores and outputs an

outline portion judged and removed as the ruled line, as a ruled-line binary image.

24. The apparatus according to claim 23, wherein said binary image combining means performs a logical operation between a binary image generated by said binary image combining means and the ruled-line binary image stored and outputted, and outputs an obtained binary image.

25. The apparatus according to claim 13, wherein said partial area extracting means judges an extremely short outline from outlines composed of edge pixels in the edge binary image as noise, removes the outlines and extracts the partial area based on an edge binary image which is composed of only remaining edge pixels.

26. The apparatus according to claim 5, wherein said partial image binary-coding means extracts the partial binary image by executing a binary-coding process for a designated partial area of the gray scale image, based on a single threshold.

27. The apparatus according to claim 26, wherein the

single threshold is determined by calculating a linear sum of mean values, standard deviation and distribution of pixel values in the designated partial area.

28. The apparatus according to claim 5, wherein said partial image binary-coding means roughly extracts a plotting area by executing a binary-coding process for a designated partial area of the gray scale image, based on a single threshold, and extracts the partial binary image by executing a local binary-coding process in which a variable threshold is obtained for each pixel in the plotting area.

29. The apparatus according to claim 28, wherein the single threshold is determined by calculating a linear sum of mean values, standard deviation and distribution of pixel values in the designated local area.

30. The apparatus according to claim 28, wherein the variable threshold is determined by calculating a linear sum of mean values, standard deviation and distribution of pixel values in a local area containing a pixel to be binary-coded in the gray

scale image corresponding to the designated partial area.

31. The apparatus according to claim 30, wherein said partial image binary-coding means changes a size of the local area according to a width of a plotting area contained in the partial area when calculating the variable threshold.

32. The apparatus according to claim 30, wherein said partial image binary-coding means changes a size of the local area according to a size of the partial area when calculating the variable threshold.

33. The apparatus according to claim 5, wherein said partial image binary-coding means calculates a gray scale partial image corresponding to a designated partial area by interpolating a pixel value of the gray scale image and executing a subpixel generating process which increases a number of pixels of an image, and extracts the partial binary image by executing the binary-coding process for the gray scale partial image.

34. The apparatus according to claim 33, wherein the

subpixel generating process includes a linear interpolation process for the pixel value.

35. The apparatus according to claim 33, wherein the variable threshold is determined by calculating a linear sum of mean values, standard-deviation and distribution of pixel values in a local area containing a pixel to be binary-coded in the gray scale image corresponding to the designated partial area.

36. The apparatus according to claim 35, wherein said partial image binary-coding means changes a size of the local area according to a width of a plotting area contained in the partial area when calculating the variable threshold.

37. The apparatus according to claim 35, wherein said partial image binary-coding means changes a size of the local area according to a size of the partial area when calculating the variable threshold.